Scalable Beamforming Radar Processor for High Resolution Imaging of Planetary Surfaces

Completed Technology Project (2015 - 2019)

Project Introduction

Many important questions in planetary science are dependent on our ability to detect and map surface and subsurface layers of planetary bodies. Particularly in dust-covered environments, it is critical to be able to expose bedrock and search for buried features that hold clues about the geologic history. Synthetic aperture radar (SAR) is the only remote sensing technique capable of imaging buried surfaces at meter-scale spatial resolution. We have developed a P-band (70 cm wavelength) digital beamforming radar concept, called the Space Exploration SAR (SESAR), capable of providing the measurement flexibility needed to address multiple types of science goals. SESAR will allow high-resolution mapping and full polarimetry of planetary targets such as the Moon and Mars, while using technology that can be optimized to produce the best possible data set for the individual science goals of each mapping region. We will design and build a prototype of SESAR's Digital Electronics System (DES) that will leverage proven advanced radar technologies and techniques developed at NASA/Goddard Space Flight Center for earth-science airplane radars such as DBSAR, the second generation DBSAR (DBSAR-2), and the P-band polarimetric and interferometric Ecosystem SAR (EcoSAR). The proposed work will reduce the power of the DES by a factor of at least 4 so that it can be used for orbital missions. Our DES programmable architecture will be able to provide multi-mode radar operation including fully polarimetric SAR imaging, multi-look angle data collection, nadir SAR altimetry, nadir sounding, and scatterometry for surface and near-subsurface remote sensing. Our proposed technology will significantly reduce the power required for SESAR and improve its TRL from 2 to 4, making this work highly relevant to the PICASSO program. No other planetary missions have used polarimetric digital beamforming, and Earth Science radars have only recently begun to use this technology at shorter wavelengths. The multi-mode and beamforming operation of SESAR allows for "smart" data collection, where one radar system can provide different data types (e.g. high- or low-res polarimetry, stereo imaging, altimetry or scatterometry) depending on the science requirements defined for each surface target.

Scalable Beamforming Radar Processor for High Resolution Imaging of Planetary Surfaces

Table of Contents

Project Introduction 1
Organizational Responsibility 1
Primary U.S. Work Locations and Key Partners 2
Project Management 2
Technology Maturity (TRL) 2
Technology Areas 2
Target Destination 3

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

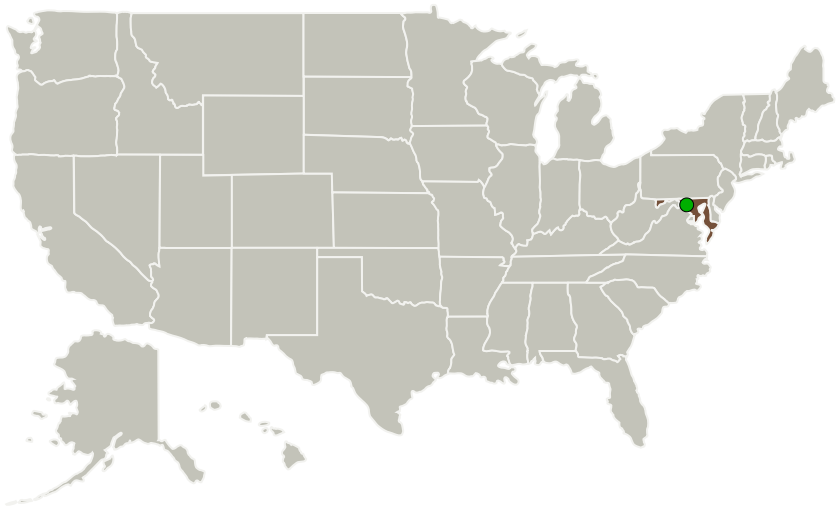
Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

Scalable Beamforming Radar Processor for High Resolution Imaging of Planetary Surfaces

Completed Technology Project (2015 - 2019)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Management

Program Director:
Carolyn R Mercer

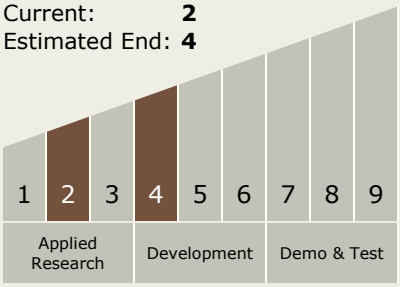
Program Manager:
Haris Riris

Principal Investigator:
Lynn M Carter

Co-Investigators:
Rafael Rincon
Daniel D Lu
David T Leisawitz

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.3 Optical Components

Scalable Beamforming Radar Processor for High Resolution Imaging of Planetary Surfaces

Completed Technology Project (2015 - 2019)

Target Destination

Others Inside the Solar System